Original Research / Orijinal Araştırma

Non-communicable Diseases and Associated Risk Factors among People Living with Human Immunodeficiency Virus in a Rural Hospital in Kenya

Kenya'da Kırsal Bir Hastanede İnsan İmmün Yetmezlik Virüsü ile Yaşayan Kişiler Arasında Bulaşıcı Olmayan Hastalıklar ve İlişkili Risk Faktörleri

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Abstract

Introduction: Non-communicable diseases are a growing burden in people living with human immunodeficiency virus (HIV). Kenya has good documentation of the prevalence of non- communicable diseases in the general population, but not in people living with human immunodeficiency virus.

Objective: The study assessed the prevalence of hypertension and diabetes mellitus and associated risk factors for non-communicable disease in this population.

Methods: We conducted a cross-sectional study with 1,595 people aged 18 to 69 in a rural HIV clinic using the World Health Organization's stepwise approach. We used descriptive statistics to examine the baseline characteristics. We reported prevalence, calculated the mean of knowledge for risk factors, and identified the factors associated with the diagnoses for non-communicable diseases by using multiple regression. We defined diabetes mellitus as fasting blood sugar ≥ 7 mmol/l (≥126mg/dl), hypertension as blood pressure≥140/90 mmHg, and obesity for men and women with waist circumference >102 cm and >88 cm, respectively.

Results: The proportion of women participants was 65.9%. Diabetes accounted for 10.3%, hypertension 9.8%, and obesity 32.7%. The ratio of those who had ever been screened for diabetes before were 9.2%, while those who had ever been screened for hypertension were 21.8%. Alcohol use was 12.5%, while physical inactivity was 15%. The mean score for knowledge of risk factors for hypertension was 0.9 and for diabetes mellitus, it was 0.3, both out of 8. Hypertension and diabetes mellitus were associated with obesity, increased number of years on antiretroviral therapy, advanced age, and physical inactivity.

Conclusion and Contribution: The study reported a high prevalence of non-communicable diseases, low knowledge of risk factors, and limited screening for non-communicable diseases highlighting missed opportunities for prevention. Implementing early screening and health education in the standard care package for HIV/AIDS (**Acquired immunodeficiency syndrome)** is crucial as a strategy for the prevention of non-communicable diseases.

Key Words: Diabetes Mellitus, Hypertension, Obesity, HIV, Non-Communicable Diseases, Risk Factors, Prevalence

Özet

Giriş: Bulaşıcı olmayan hastalıklar, insan immün yetmezlik virüsü (Human immunodeficiency virus-HIV) ile yaşayan kişilerde giderek artan bir yük oluşturmaktadır. Kenya, genel nüfusta bulaşıcı olmayan hastalıkların yaygınlığına ilişkin iyi belgelere sahiptir, ancak insan immün yetmezlik virüsü ile yaşayan kişilerde bu durum söz konusu değildir.

Amaç: Bu çalışmada hipertansiyon ve diabetes mellitus prevalansı ve bu popülasyonda bulaşıcı olmayan hastalıklar için ilişkili risk faktörleri değerlendirilmiştir.

Yöntemler: Dünya Sağlık Örgütünün aşamalı yaklaşımını kullanarak kırsal bir HIV kliniğinde 18-69 yaş arası 1.595 kişiyle kesitsel bir çalışma yürüttük. Temel özellikleri incelemek için tanımlayıcı istatistikler kullandık. Prevalansı bildirdik, risk faktörleri için bilgi ortalamasını hesapladık ve çoklu regresyon kullanarak bulaşıcı olmayan hastalıklar için tanılarla ilişkili faktörleri belirledik. Diyabetes mellitusu açlık kan şekeri ≥ 7 mmol/l (>126mg/dl) hipertansiyonu ≥140/90 mmHg ve obeziteyi erkekler ve kadınlar için sırasıyla bel çevresi >102 cm ve >88 cm olarak tanımladık.

Sonuçlar: Kadın katılımcıların oranı %65,9 idi. Diyabet oranı %10,3, hipertansiyon %9,8 ve obezite %32,7'dir. Daha önce diyabet taraması yapılanların oranı %9,2, hipertansiyon taraması yapılanların oranı ise %21,8'dir. Alkol kullanım sıklığı %12,5 iken fiziksel hareketsizlik sıklığı %15'tir. Hipertansiyon için risk faktörleri bilgi puanı ortalaması 0,9 ve diabetes mellitus için 0,3 olup her ikisi de 8 üzerinden değerlendirilmiştir. Hipertansiyon ve diabetes mellitus obezite, antiretroviral tedavide geçirilen yıl sayısının artması, ileri yaş ve fiziksel hareketsizlik ile ilişkilendirilmiştir.

Sonuç ve Öneri: Çalışma, bulaşıcı olmayan hastalıkların yüksek prevalansını, risk faktörleri hakkında düşük bilgi düzeyini ve bulaşıcı olmayan hastalıklar için sınırlı taramayı rapor ederek önleme için kaçırılan fırsatları vurgulamıştır. HIV/AIDS (Acquired immunodeficiency syndrome-kazanılmış immün yetmezlik sendromu**)** için standart bakım paketinde erken tarama ve sağlık eğitiminin uygulanması, bulaşıcı olmayan hastalıkların önlenmesi için bir strateji olarak çok önemlidir.

Anahtar Kelimeler: Diabetes Mellitus, Hipertansiyon, Obesite, HIV, Bulaşıcı olmayan hastalıklar, Risk Factörleri, Prevalans

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Introductıon

While human immunodeficiency virus (HIV) is still a global health concern, non-communicable diseases (NCDs) are a growing source of morbidity and mortality in low-income countries, with an estimated 41 million global deaths annually, 80% of which occur in low-income countries.[1] NCDs pose an increasing challenge to the health systems in Sub-Saharan Africa, which still struggle to tackle other health issues like infectious diseases and maternal, neonatal, child, and adolescent health.[2]

The dual HIV and NCD epidemic is a public health priority in low-income countries like Kenya, just like it is in many Sub-Saharan African countries.[3] The success of antiretroviral therapy (ART) in sub-Saharan Africa has led to low morbidity and mortality associated with HIV; thus, an increasingly aging population is susceptible to NCDs.[4] Besides, NCDs are associated with chronic inflammation, immune activation associated with HIV infection, and opportunistic infections.[5] Some antiretroviral (ARV) regimens have been associated with NCDs. For instance, protease inhibitors (PI) have been linked to hypertension.[6] Given the magnitude of the emerging NCD epidemic in low- and middle-income countries, including Kenya, the NCDs' impact on individuals and households, health systems, national economies, and governments resonate globally. The World Economic Forum projects that the NCD epidemic will inflict $21.3 trillion in economic losses in low- and middle-income countries over the next two decades, which is nearly the same as the total gross domestic product (GDP) of the countries ($24.5 trillion) in 2013.[7]

High awareness of NCDs and their risk factors, including awareness of cervical cancer screening, is also crucial in averting the high health and economic burden that the diseases situate.[8] With the paucity of data on NCDs among People Living with HIV (PLHIV) in Kenya, the study determined the prevalence of and screening for NCDs, specifically diabetes mellitus (DM), hypertension and obesity; the shared risk factors; and the level of knowledge of NCD risk factors.

Research Methods and Desıgn

Study Design and Setting

The study adopted a cross-sectional survey design to collect data on the prevalence of NCDs and the screening for the NCDs specifically diabetes, hypertension, obesity, the prevalence of the shared risk factors, the level of knowledge of cervical cancer screening, and the level of knowledge of the NCD risk factors.

The study site was an HIV clinic within the primary healthcare hospital in a rural setting in Homa Bay County, Kenya, with a catchment population of 13,506 people whose main occupation was small-scale farming. It was one of the sites where the county government was piloting a separate NCD clinic to manage already diagnosed NCDs with support from Medicine San Frontiers (MSF). Homa Bay County has the highest HIV prevalence in Kenya, recording 20%, while the national HIV prevalence is 4.9%.[9] We conducted the study between July and December 2021, we recruited participants in the first week of July, and data collection took place between July and September 2021.

Study Population and Sampling Strategy

The principal investigator obtained a listing of adults aged 18 to 69 as specified in the WHO stepwise approach to NCD surveillance that this study adopted. The list of participants, enrolled at the HIV clinic, was obtained from the hospital records. The hospital had an up-to-date electronic medical record system that listed all active patients on HIV care with a total number of 2,125. We sampled individual patients using the simple random procedure of random table numbers.

The inclusion criteria were: (1) consent to participate and (2) being on ART for at least six months. The study excluded PLHIV who were newly-enrolled at the time of the study, HIV patients younger than 18 years old or more than 69 years old, those who declined to participate, and those who were too frail to participate.

Sample size

The study used the detailed recommendations in the steps manual for sample size calculation.[10] The sample population was drawn by use of age-sex groups.

The sample size for the study was calculated as shown below:

$$n = \frac{Z^2 P(1-P)}{e^2}$$

Where: n = sample size

Z = level of confidence, which is 1.96, associated with a 95% confidence interval; P = baseline level of the indicators, which is 0.5 (estimated prevalence of one NCD); and e = margin of error, which is 0.05.

$$n = \frac{1.96^2 0.5(1-0.5)}{0.05^2}$$

$$= 384.16.$$

Before factoring in the design effect and the non-response values, this was the initial sample size. Since the target population was very small (approximately less than 50,000 people), just like the total PLHIV in Marindi Sub-County Hospital was 2,125 (supplementary material 1), the sample size was calculated using a Finite Population Correction (FPC).

According to World Health Organization (WHO), eight age-sex estimates are required for both men and women, as shown below:

18-29, 30-44, 45-59, and 60-69.

The target population for each group was divided by 384.16. The target population for men 18-29 was 57, and the following formula was used to get the new *n*.

$$n = \frac{n}{1+\frac{n}{\frac{Population}{384.16}}}$$

$$1+\frac{384.16}{57}$$

$$= 49.64.$$

This was the sample size for men 18-29. The procedure was repeated for all the age-sex groups (Supplementary material 2). The total new sample size, 1024.77, was multiplied by 1.5, which is the design effect, and adjusted for expected non-response. The response rate is usually 95% from the experience of similar studies.

The new sample size *n* was 1,024.77, multiplied by the design effect (1.5) and the non-response rate of 5 per cent incorporated. Therefore, our sample size was 1,618.

Data Collection Instruments and Study Measurements

We adopted the standardized WHO stepwise approach to NCD surveillance using a standardized tool, a sequential process beginning with data collection on common NCD risk factors, moving to simple physical measurements, and finally collecting blood samples for biochemical analysis. We added the questions on knowledge of risk factors for DM and hypertension to the questionnaire.

We pre-tested the tool for validity and reliability with 20 PLHIV in Nyalkinyi Health Center in Homa Bay County. The choice for the pre-test site was its similar set-up, which is rural, to the study site, and it is also the second site that the county government considered for the implementation of the management of NCD with support from MSF, just like the study site. The value for Cronbach's alpha co-efficient was 0.86 indicating good internal consistency of the tool.

Physical measurements

The blood pressure (BP) was taken using one pre-calibrated *Omron BP* monitor model number *BPA2 Classic* made in Japan from the left arm three times at three minutes intervals. The average of the two last readings was used in the analysis.[11] High blood pressure was defined as readings of ≥140/90 mmHg or cases already on hypertension medication.[11]

An *ADE model M308880* weighing scale by ADE Germany with calibration date of 1st June 2021 by biomedical department of Homa bay County was used to take weight in kg to 100g precision, while height measurement was taken using *206 SECA* roll-up measuring tape microtoise by SECA GmbH, Germany in cm to 0.1cm precision. Body mass index (BMI) was calculated as weight (in Kilograms) divided by height in meters squared (m^2), and obesity was defined as BMI≥30 kg/m^2.[12]

Waist measurement was taken with a retractable tape measure. The measurement was made at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest as per WHO guidelines.[13] We defined central obesity as waist circumference >88 cm for women and >102 cm for men.[12]

Biochemical measurements

Participants were instructed a day before the interview to fast for at least 8 hours before the test for sample collection. Trained laboratory technicians in Marindi Sub County Hospital conducted the tests. A blood sample was taken by finger prick (capillary) and measured using on-call plus machine and on-call blood glucose test strips from *ACON* Laboratories from the USA. Diagnosis of diabetes mellitus was made according to WHO classification, and the International Federation of Diabetes (IDF), whereby fasting blood sugar (FBS) ≥ 7.0 mmol/L(126mg/dl) was considered as hyperglycemia and FBS of between 6.1 and <6.9 mmol/L (110-125mg/dL) was considered impaired and normal ranges below 6.1mmol/L (<125mg/dL). For those who had not fasted, random blood sugar (RBS) was done, and any reading ≥11.0 mmol/L (200mg/dL) was considered raised blood sugar, while RBS ≥ 7.8 and <11.1(140-200) was considered impaired, and any value below 7.8mmol/L (140mg/dL) was considered normal.[14] Participants with raised blood glucose and not on medication were referred to the hospital's NCD clinic for further assessment and or management/follow-up as per the recommendations.

Using automated measuring devices like the BP machine and standardized questionnaires reduced information bias. Data collection was carried out in the health facility where PLHIVs routinely obtain ARVs. Their consent was taken in the presence of an enumerator/ assistant principal investigator, and their demographic information and physical measurements were also taken. Data collection was aided by the electronic data-capturing devices using *kobocollect.*

Study Variables

The primary outcome variables were the prevalence of DM, hypertension, obesity, and knowledge of the risk factors. The participants were also asked if they knew how to conduct a self-risk assessment and if they knew any risk factors for hypertension and diabetes mellitus. They listed the answers unprompted. Other variables were NCD risk factors like tobacco use, physical inactivity, alcohol use, and recommended fruit and vegetable servings. Additional variables mentioned in this study were years on ART, screening for hypertension, diabetes, and cervical cancer.

Diagnostic Criteria for other variables

We defined current tobacco use as the use of any tobacco product such as cigarettes, hand-rolled, cigars or pipes/ kiko, shisha in the past 30 days; alcohol consumption as the use of alcohol in the past 30 days. We defined recommended fruit and vegetable consumption as consumption of five or more servings of fruits and vegetables per day. We defined physical activity as engaging in at least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.

Data Management

Data were anonymous and non-identifiable in accordance with the Data Protection Act and ethical procedures. To protect data collected but also minimize the risk of misuse by third parties, each electronic tablet was passcode-enabled with a 4-digit code.

All devices were 'restricted' prior to use by means of disabling all the non-study specific applications on the device. This means that data collectors did not use the device for personal emails, accessing social media, the internet, or any other personal activity. Data collectors were given the access code to their own device, but only the principal investigator had the 'master list' of access and restriction codes. After submission of finalized forms, the forms in the android tablets were deleted. Data were backed up by downloading securely the excel format and securely stored in the principal investigator's hard drive. Raw data were stored in a coded format, accessed only by the principal investigator. There was anonymization of data before analysis. Participants received an assurance that study investigators will strictly protect the confidentiality of individual information

Data Analysis

Data cleaning was done by using Microsoft Excel and IBM Statistical Package for Social Sciences (SPSS) version 25 from the United States. The data were then exported to Epi Info Software version 7.2.4.0 by Centre for Diseases Control, USA to generate the standard WHO STEPS tabulations. Descriptive statistics were used to examine the baseline characteristics. Prevalence was reported as percentages, the mean score of knowledge for risk factors was calculated out of a possible 8, and multiple regression was used to identify factors associated with NCDs diagnoses. Statistical significance was considered for a p-value of <0.05.

Results

Demographic and Health Characteristics

Out of the sampled 1618 participants, 1595 (98.6%) consented to participate. Women consisted of 1051 (65.9%), and the median (interquartile range) age was 41 (25-50) (Table 1). Participants who attained less than primary education were 41.7%, those who completed primary but did not complete secondary education were 42.9%, and only 4.6% had post-secondary education. The median ART (IQR) duration was 7 (4-11) years. Prevalence of alcohol use was 12.5%, physical inactivity was 15%, and meeting recommended fruit and vegetable intake was very low at 3%. Knowledge of conducting self-risk assessment was very low at 2.1%. Participants with knowledge of cervical cancer screening were 69.6%, while women who had not been screened for cervical cancer were 66%, and participants who had never been screened for diabetes and hypertension were 90.8% and 78%, respectively. Other characteristics are presented in Table 1.

Table 1: *Demographic and Health Characteristics*

Characteristics of Study Participants	
Characteristics	**Total (n= 1595)**
Female, n (%)	1051 (65.9)
Median age, y(IQR)	41 (25-50)
Mean age, y(SD)	41.6(11.7)
Overall age data	
18-29	273 (17.1)
30-44	693 (43.4)
45-59	510 (32.0)
60-69	119(7.5)
Education, n (%)	
No formal education	665 (41.7)
Primary level	684(42.9)
Secondary level	173(10.8)
Tertiary level	73(4.6)
Marital status, n (%)	
Never married	62 (3.9)
In union	1195 (74.9)
Separated	55(3.4)
Widowed	283 (17.7)
HIV related characteristics	
Median ART duration, y (IQR)	7.0(4.0-11.0)
Mean ART duration, y (SD)	7.7 (4.1)
ARV regimen, n (%)	
1st line	1400 (87.8)
2nd line	176 (11)
Others	19 (1.2)
Ever measured BP, n (%)	147 (9.2)
Ever measured BG, n (%)	347 (21.8)
Ever screened for CC (women), n (%)	358(34)
Tobacco use, n (%)	18(1.1)
Alcohol use, n (%)	199 (12.5)
Physical inactivity, n (%)	239 (15)
Recommended fruit and vegetable servings, n (%)	48 (3)
Conducting self-risk assessment	34 (2.1)
Knowledge of CC screening methods, n (%)	1105(69.6)

IQR:Inter-quartile range, SD:Standard deviation, BP:Blood pressure, BG:Blood glucose, CC: Cervical cancer

Diabetes Mellitus

The study reported that one in ten people had hyperglycemia, a prevalence of 10.3%, women representing 10.7% and men representing 9.7% (Figure 1A).

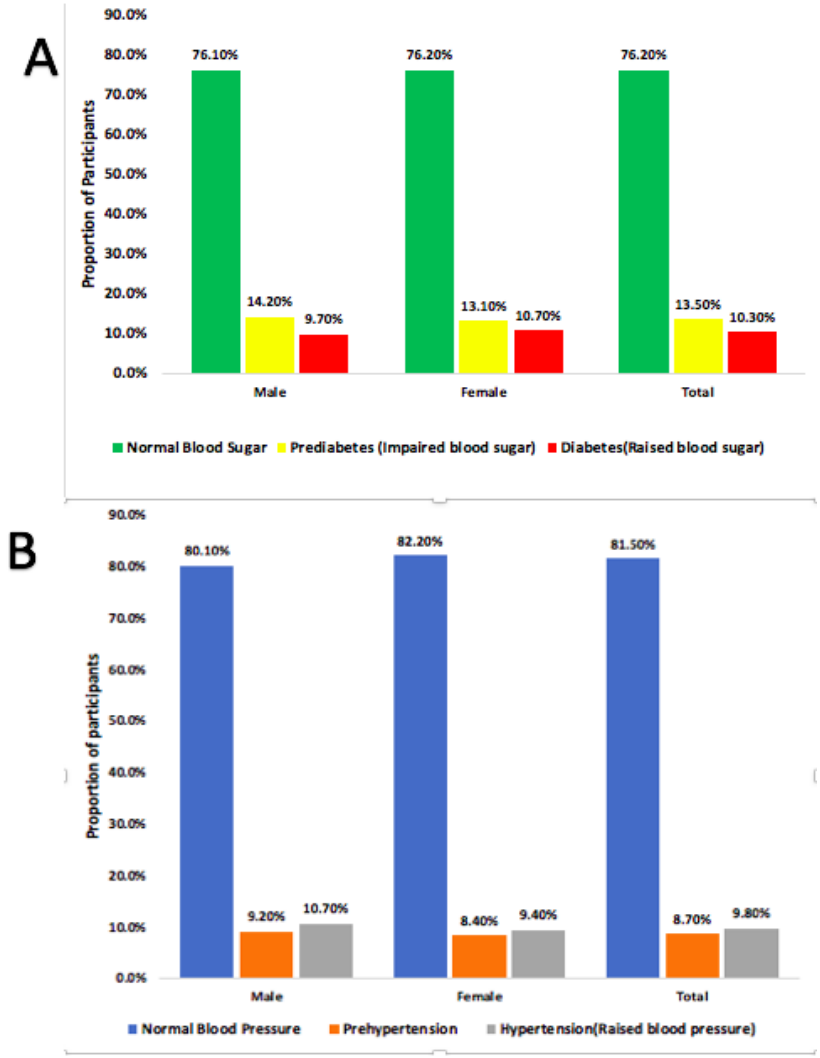

Figure 1: *Prevalence of Diabetes Mellitus and Hypertension*

Participants with impaired blood glucose (prediabetes), defined as fasting blood sugar between 6.1 and 6.9mmol/l(110-125mg/dL) and random blood sugar between 7.8 and 11mmol/l (140-200mg/dL), accounted for 13.5%; men represented 14.2%, while women represented 13.1%. Results for multiple regression analysis to identify associated factors for DM showed a significant association with many years on ART, hypertension, obesity, education level, and advanced age, all with p values of 0.001 while gender did not show any significance (Table 2). Therefore, diabetes was associated with an increased number of years on ART, hypertension, obesity, level of education, and advanced age.

Hypertension

The study reported a prevalence of 9.8%, with women at 9.4% and men accounting for higher prevalence at 10.7%. Participants with systolic blood pressure ranging from 130 to 139mm/Hg and diastolic of 80 to 89mm/ Hg (pre-hypertensive) were 8.7% (Figure 1B).

The multiple regression analysis indicated that obesity, increased number of years on ART, and DM were significantly associated with hypertension with p-values of 0.001 while gender was not significantly associated (Table 2). Therefore, high blood pressure was strongly associated with obesity, more years on ART, and raised blood sugar.

Table 2: *Multiple Regression Analysis to Identify Associated Factors for Diabetes Mellitus and Hypertension Diagnoses*

Diabetes Mellitus		Unstandardized coefficients		Standardized coefficients	T	Sig.
		B	Std. error	Beta		
1	(Constant)	.686	.132		5.220	.001
	Gender	.029	.034	.021	.863	.388
	No. of years on ARTs	.018	.004	.116	4.594	.001
	Age	.056	.019	.071	2.895	.004
	Highest education level	.027	.012	.058	2.227	.026
	Raised BP	.113	.026	.109	4.304	.001
	Obesity	.098	.021	.117	4.688	.001
	Routine exercising	-.118	.076	-.040	-1.547	.122
Coefficients						
Hypertension		Unstandardized coefficients		Standardized coefficients	T	Sig.
		B	Std. error	Beta		
1	(Constant)	.707	.125		5.660	.001
	Gender	-.022	.032	-.017	-.693	.488
	No. of years on ARTs	.023	.004	.153	6.136	.001
	Highest education level	-.008	.011	-.017	-.673	.501
	Obesity	.139	.020	.172	7.006	.001
	Routine exercising	-.026	.072	-.009	-.359	.719
	DM Status	.102	.024	.106	4.304	.001
a. Dependent Variable: raised BP						

ART:Anti-retroviral therapy, BP: Blood pressure, DM: Diabetes mellitus

Obesity

The study recorded that approximately one-third of the population was overweight/obese (Figure 2A). The ratio of overweight/ obese by BMI was 35%, while obesity by waist circumference (central obesity) also presented almost similar results (32.73%) (Figure 2B).

For men, central obesity was higher at 36.0% than for women at 31.02%. Two-thirds of the participants were either obese or at increased risk of central obesity (Figure 2A).

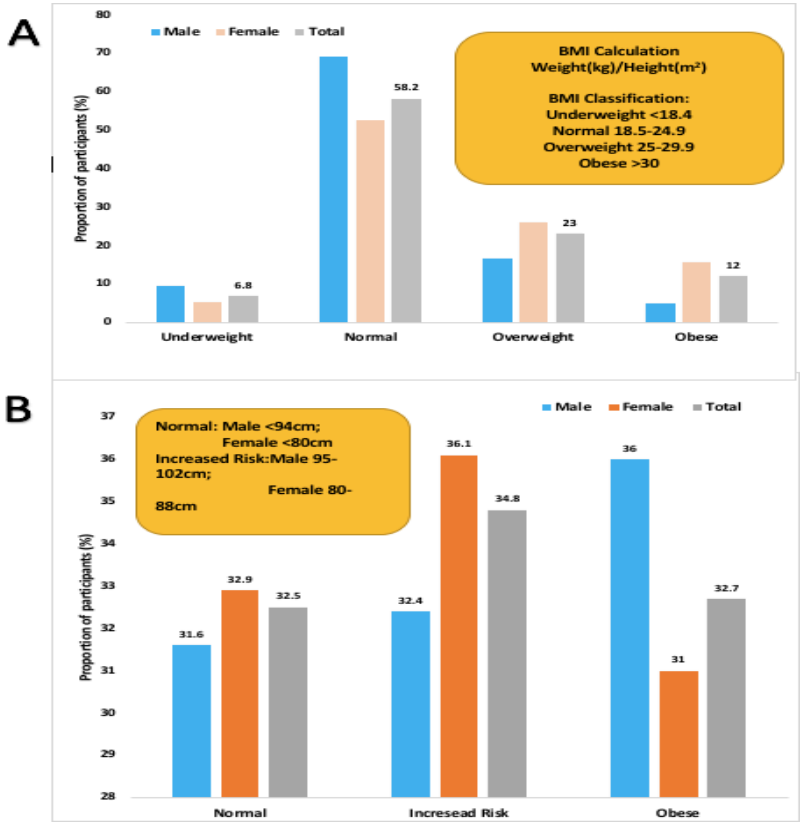

Figure 2: *Obesity by BMI and Waist Circumference*

Knowledge of Risk Factors for DM and hypertension

Only 2.1% reported having knowledge of conducting a self-risk assessment after responding to the first question on knowledge of how to conduct self-assessment (Table 1). The second part of the open-ended question asked the participants to list risk factors for DM and also hypertension separately. There were possible eight responses for each NCD. These 8 responses were scored against the participants' answers. Any correct response was scored out of 8 such that a participant who got three correct responses was deemed as having scored three out of eight. The mean score for the level of knowledge for diabetes was 0.3, while for hypertension was 0.9 (Table 3).

Table 3: *Mean Risk Factors for Diabetes Mellitus and Hypertension*

	Means Risk Factors for Hypertension	**Mean Risk Factors for DM**
Mean	**0.885**	**0.307**
Variance	0.972	0.519
Observations	1595	1595
Pearson correlation	-0.029	0.211
Hypothesized mean difference	0.001	0.001
Df	1594	1594
t Stat	-69.047	-92.145
P(T<=t) one-tail	0.001	0.001
t Critical one-tail	1.646	1.646
P(T<=t) two-tail	0.001	0.001
t Critical two-tail	1.961	1.961

Discussion

The study determined the prevalence of NCDs, and the primary outcomes were diabetes mellitus, hypertension, and obesity. It sought to estimate the prevalence of four shared risk factors for NCDs: tobacco use, alcohol consumption, unhealthy diet (limited fruit/ vegetable consumption), and physical inactivity. The study also determined the nutrition status by BMI and waist circumference of the PLHIV. The study assessed the knowledge of NCD risk factors and how to conduct NCD self-risk assessment.

Prevalence of Diabetes Mellitus

According to the IDF atlas 10th edition 2021, it is estimated that Kenya has a prevalence of diabetes of 4.0% in the general population, impaired fasting blood glucose prevalence of 5.0%, and a proportion of 43.7% undiagnosed people.[15] These prevalences are lower than the prevalence in this study (10.34% for raised blood glucose and 13.48% for impaired blood sugar, respectively), and this concurs with most studies that the prevalence of NCDs is higher in PLHIV than in HIV negative population.[16]

The higher prevalence of raised blood sugar among women than men at 10.66% and 9.74%, concurs with findings of a study in the US which also recorded a higher prevalence of diabetes among women living with HIV than among men living with HIV. It concluded that there are increased odds of DM among women.[17] However, in this study, the multiple regression analysis did not find any significant difference in the prevalence of DM based on gender.

HIV or more prolonged ART use may impact the cause of raised blood sugar, which is probably why this study finds a higher prevalence. Those with raised blood sugar had been on ART for an average of over 9 years. The study findings also linked many years of ART, hypertension, and increased age with DM. The findings concur with several studies. According to a London study, factors associated with raised blood sugar were advanced age, hypertension, ARV use, high waist circumference, weight gain and low physical activity.[18] Another cohort study in Canada reported that diabetes diagnosis was most likely in PLHIV who had started ART in earlier eras (1997-2004) with earlier regimens like Stavudine.[19] Less than 10% of the study participants are on a PI-based regimen, and more than 80% are on integrase inhibitors–based regimen, which the same study does not link to hyperglycemia. However, this study did not look at the ARV regimen and raised blood sugar.

The findings were similar to a Sweden cohort study where obesity was associated with developing type 2 diabetes,[20] and rapid development of impaired blood glucose/ diabetes and overweight/obesity after ART initiation.[21] In this study, nearly a quarter (24.76%) of the respondents with raised blood sugar also had raised blood pressure indicating that hypertension is a risk factor for diabetes. This corroborates the review of current concepts on the relationship between DM and hypertension, which is that most people with diabetes are hypertensive.[22]

Prevalence of Hypertension

More than three-quarters (78.18%) reported that they had never had their blood pressure measured. This resonates with other studies that screening for hypertension is limited among PLHIV. In a Brazillian study, 44.3% reported that their blood pressure had never been taken. For those who were hypertensive, only 33.6% had prior knowledge of their hypertensive status. A study in Malawi indicated that 94% of PLHIV who were found to be hypertensive did not know their hypertension status.[23] This indicates that despite the weight that the burden of hypertension has on morbidity, mortality and the healthcare system, screening for hypertension is not prioritized in HIV/AIDS care.

The study reported a higher prevalence of hypertension in men than in women, with men recording 10.66% and women at 9.42%. This concurs with a study conducted in South Africa, which had a higher prevalence of hypertension among men than women. Another systematic review and meta-analysis found no difference between men and women[24]. Similarly, with the multiple regression analysis in this study, there was no significant difference in gender.

The participants with raised blood pressure have been on ART for an average of 9.7 years.

The findings are similar to those of several studies that found increased age and receiving ART associated with hypertension. The meta-analysis found that 34.7% were ART-experienced and 12.7% for ART-naïve, while a study found that age and BMI were independently associated with higher prevalent hypertension risk.[25] This study also found obesity, more years on ART, and having diabetes to be associated with hypertension.

Prevalence of Obesity

Obesity is a risk factor for cardiovascular diseases and other NCDs. In this study, about a third of the participants were overweight/ obese, while nearly two-thirds were either at increased risk of central obesity or had central obesity despite the majority being physically active (only 15% were physically inactive). The findings demonstrating that only 3% of participants met the recommended fruit and vegetable intake pointed towards the unhealthy dietary intake by this population which is a possibility for the high prevalence of obesity.

More than half of PLHIV who had either hypertension or diabetes were obese. However, a higher prevalence of these diagnoses was observed with increased age. These findings concur with a Kenyan study on the high prevalence of NCDs among key populations which recorded a higher prevalence of obesity with increased age.[26]

Knowledge of NCD Risk Factors

The low level of knowledge for hypertension and DM reported in this study are similar to some study findings. The findings of a systematic review in Saudi Arabia reported that 86.7% of the participants had poor to moderate knowledge, 12.4% thought that eating an excess of sweets was a risk factor, and mean knowledge score of 57% concur with the findings of this study on low level of knowledge of risk factors for DM.[27]

The low-level knowledge suggests that PLHIV are accessing minimal or no knowledge on risk factors for hypertension and diabetes.

For both genders in this study, 69.6% had heard of cervical cancer screening (CCS) methods. The level of awareness of CCS methods is higher than that of a study conducted in Ethiopia, which reported 45.1%, and in Kenya, which reported 43%. The higher level of awareness in this study could result from the cancer screening awareness included in the HIV care package since the two studies which recorded lower awareness was carried out among the general population. However, despite the higher level of awareness, this study reported that only 34% of the women had ever been screened. This does not differ much from the studies done on the general population in Ethiopia and India, which reported 22.9% and 29.8%, respectively.[28–30] This could indicate that the level of awareness does not necessarily translate into practice among the PLHIV.

Strengths and Limitations

To the best of our knowledge, our findings are the first to determine the prevalence of hypertension and DM among PLHIV in rural populations with the highest HIV prevalence in Kenya. Using the standardized WHO data collection tool also gives this study credibility. However, the study has some limitations. The study is cross-sectional and provides just a snapshot of the risk and disease burden at a particular moment. The study was conducted only in a rural site in Kenya and is therefore not nationally representative considering the urban areas.

Conclusıon

The current study findings support the concept that HIV and NCDs are major problems of public health importance in developing countries, given the high prevalence of NCDs among PLHIV, a high level of overnutrition, a low level of NCD risk factors awareness, and a high level of selected risk factors for NCDs among PLHIV.

The findings from this study are essential to inform the strengthening of the surveillance system, resources, and research priorities. There is an urgent need for health interventions like early screening and health education to control risk factors in an era of HIV to reduce multiple morbidities of chronic diseases. It is also essential to address the occurrence of NCDs and their risk factors to achieve the positive effects of long-term ART. Therefore, monitoring the interaction of HIV, ART use, and non-communicable diseases is needed at both individual and population levels.

Ethical Considerations

The study obtained approval from Euclid University Research and Ethics Committee, Maseno University Ethical Review Committee Proposal No. MUERC/968/21, The National Commission for Science, Technology, and Innovation (NACOSTI) License No: NACOSTI/P/21/10507, and authorization from Homa Bay County Health Department REF: MOH/RA/VOL.VII (29).

All respondents were of age to give consent, that is, above 18 years old. The principal investigator read the consent form to the participants and consent was obtained in the presence of the data collector before data collection. We ensured that each respondent understood that "participation in the study was completely voluntary and refusing to participate would not affect their treatment, and that they could also withdraw at any point." Participants were also informed that their confidentiality would be protected.

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Conflict of Interest

The authors declare no conflict of interest.

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Artificial Intelligence

The authors confirm that no artificial intelligence (AI) tools or AI-assisted technologies were used in the writing or preparation of this manuscript.

References

1. Duffy M, Ojikutu B, Andrian S, Sohng E, Minior T, Hirschhorn LR. Non-communicable diseases and HIV care and treatment: models of integrated service delivery. *Tropical Medicine & International Health*. 2017;22(8):926-937. doi:10.1111/tmi.12901
2. Gouda HN, Charlson F, Sorsdahl K, et al. Burden of non-communicable diseases in sub-Saharan Africa, 1990–2017: results from the Global Burden of Disease Study 2017. *The Lancet Global Health*. 2019;7(10):e1375-e1387. doi:10.1016/S2214-109X(19)30374-2
3. Zungu N, Mabaso M, Kumalo F, et al. Prevalence of non-communicable diseases (NCDs) and associated factors among HIV positive educators: Findings from the 2015/6 survey of Health of Educators in Public Schools in South Africa. *PLoS ONE*. 2019;14.
4. Ekrikpo U, Akpan E, Ekott J, Bello A, Okpechi I, Kengne A. Prevalence and correlates of traditional risk factors for cardiovascular disease in a Nigerian ART-naive HIV population: a cross-sectional study. *BMJ Open*. 2018;8.
5. Biraguma J, Mutimura E, Frantz J. Knowledge about modifiable risk factors for non-communicable diseases adults living with HIV in Rwanda. *African Health Sciences*. 2019;19:3181-3189.
6. Ciccacci F, Tolno VT, Doro Altan AM, et al. Noncommunicable Diseases Burden and Risk Factors in a Cohort of HIV+ Elderly Patients in Malawi. *AIDS Res Hum Retroviruses*. 2019;35(11-12):1106-1111. doi:10.1089/AID.2019.0125
7. Daniels ME, Donilon TE, Bollyky TJ. *The Rising Epidemic of NCDs in Low- and Middle-Income Countries*. Council on Foreign Relations; 2014:9-18. doi:10.2307/resrep24187.8
8. Ataklte Feven, Erqou Sebhat, Kaptoge Stephen, Taye Betiglu, Echouffo-Tcheugui Justin B., Kengne Andre P. Burden of Undiagnosed Hypertension in Sub-Saharan Africa. *Hypertension*. 2015;65(2):291-298. doi:10.1161/HYPERTENSIONAHA.114.04394
9. NASCOP. *Kenya HIV Progress Report 2020: World AIDS Day*. National AIDS and STI Control Programme; 2020. Accessed November 28, 2023. https://www.nascop.or.ke/
10. World Health Organization. *The WHO STEPwise Approach to Noncommunicable Disease Risk Factor Surveillance*.; 2017. Accessed July 28, 2024. https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/steps
11. World Health Organization. *WHO Technical Specifications for Automated Non-Invasive Blood Pressure Measuring Devices with Cuff*.; 2020:72. Accessed July 28, 2024. https://cdn.who.int/media/docs/default-source/searo/indonesia/who-tech-spec-for-automated-non-invasive-blood-pressure-measuring-devices-with-cuff.pdf?sfvrsn=b112be47_2

12. Ross R, Neeland IJ, Yamashita S, et al. Waist circumference as a vital sign in clinical practice: a Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity. *Nature Reviews Endocrinology*. 2020;16(3):177-189. doi:10.1038/s41574-019-0310-7
13. World Health Organization. *Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, Geneva, 8-11 December 2008*. World Health Organization; 2011. https://www.who.int/publications/i/item/9789241501491
14. World Health Organization, International Diabetes Federation. *Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycaemia: Report of a WHO/IDF Consultation*.; 2006. Accessed January 5, 2021. http://www.who.int/diabetes/publications/diagnosis_diabetes2006/en/
15. International Diabetes Federation. *IDF Diabetes Atlas 10th Edition 2021*. IDF Africa Region; 2021. Accessed July 8, 2024. https://diabetesatlas.org/data/en/country/104/ke.html
16. Njuguna B, Kiplagat J, Bloomfield GS, Pastakia SD, Vedanthan R, Koethe JR. Prevalence, Risk Factors, and Pathophysiology of Dysglycemia among People Living with HIV in Sub-Saharan Africa. Saely CH, ed. *Journal of Diabetes Research*. 2018;2018:6916497. doi:10.1155/2018/6916497
17. Todowede OO, Sartorius B. Todowede, Olamide O; Sartorius, Benn; (2017) Prevalence of metabolic syndrome, discrete or comorbid diabetes and hypertension in sub-Saharan Africa among people living with HIV versus HIV-negative populations: a systematic review and meta-analysis protocol. BMJ. In: BMJ Open; 2017. doi:10.1136/bmjopen-2017-016602
18. Duncan AD, Goff LM, Peters BS. Type 2 diabetes prevalence and its risk factors in HIV: A cross-sectional study. *PLOS ONE*. 2018;13(3):e0194199. doi:10.1371/journal.pone.0194199
19. Samad F, Harris M, Puskas CM, et al. Incidence of diabetes mellitus and factors associated with its development in HIV-positive patients over the age of 50. *BMJ Open Diab Res Care*. 2017;5(1):e000457. doi:10.1136/bmjdrc-2017-000457
20. Bratt G, Brännström J, Missalidis C, Nyström T. Development of type 2 diabetes and insulin resistance in people with HIV infection: Prevalence, incidence and associated factors. Andrei G, ed. *PLOS ONE*. 2021;16(6):e0254079. doi:10.1371/journal.pone.0254079
21. Gomes A, Reyes EV, Garduno LS, et al. Incidence of Diabetes Mellitus and Obesity and the Overlap of Comorbidities in HIV+ Hispanics Initiating Antiretroviral Therapy. *PLoS ONE*. 2016;11.
22. Oktay AA, Akturk HK, Jahangir E. Diabetes mellitus and hypertension: a dual threat. *Current Opinion in Cardiology*. 2016;31(4). https://journals.lww.com/co-cardiology/Fulltext/2016/07000/Diabetes_mellitus_and_hypertension__a_dual_threat.11.aspx
23. Mitambo C, Khan S, Matanje-Mwagomba BL, et al. Improving the screening and treatment of hypertension in people living with HIV: An evidence-based policy brief by Malawi's Knowledge Translation Platform. *Malawi Medical Journal*. 2017;29:224-228.
24. Bigna JJ, Ndoadoumgue AL, Nansseu JR, et al. Global burden of hypertension among people living with HIV in the era of increased life expectancy: a systematic review and meta-analysis. *Journal of Hypertension*. 2020;38(9). Accessed July 8, 2024. https://journals.lww.com/jhypertension/Fulltext/2020/09000/Global_burden_of_hypertension_among_people_living.5.aspx
25. Xu Y, Chen XJ, Wang K. Global prevalence of hypertension among people living with HIV: a systematic review and meta-analysis. *Journal of the American Society of Hypertension : JASH*. 2017;11 8:530-540.
26. Achwoka D, Oyugi J, Mutave R, et al. High prevalence of non-communicable diseases among key populations enrolled at a large HIV prevention & treatment program in Kenya. *PLoS ONE*. 2020;15.
27. Alanazi FK, Alotaibi JS, Paliadelis P, Alqarawi N, Alsharari A, Albagawi B. Knowledge and awareness of diabetes mellitus and its risk factors in Saudi Arabia. *Saudi Medical Journal*. 2018;39(10):981-989. doi:10.15537/smj.2018.10.22938
28. Tekle T, Wolka E, Nega B, Kumma WP, Koyira MM. Knowledge, Attitude and Practice Towards Cervical Cancer Screening Among Women and Associated Factors in Hospitals of Wolaita Zone, Southern Ethiopia. *Cancer Management and Research*. 2020;Volume 12:993-1005. doi:10.2147/CMAR.S240364
29. Krishnamoorthy Y, Ganesh K, Sakthivel M. Prevalence and determinants of breast and cervical cancer screening among women aged between 30 and 49 years in India: Secondary data analysis of National Family Health Survey - 4. *Indian J Cancer*. Published online January 27, 2021. doi:10.4103/ijc.IJC_576_19
30. Ministry of Health, Kenya National Bureau of Statistics. *Kenya STEPwise Survey for Non-Communicable Diseases Risk Factors 2015 Report*. Division of Non Communicable diseases Afya house, Cathedral Road; 2015. Accessed July 8, 2024. https://www.knbs.or.ke/kenya-stepwise-survey-for-non-communicable-diseases-risk-factors-2015-report/